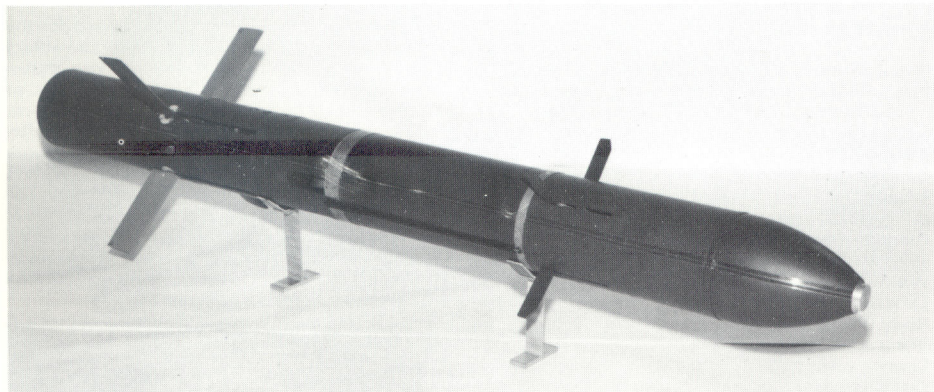


KAM-9 (TAN-SSM)

Japan



Anti-tank or anti-ship missile. In production and service.

Prime contractor: Kawasaki Heavy Industries Ltd

Powered by: Daicel dual-thrust solid-propellant sustainer. Nippon Oils and Fats Co solid-propellant rocket booster

Guidance and Control: Nippon Electric Co wire-guidance system, with optical aiming and probably infra-red tracking

Warhead: Hollow charge with piezoelectric fuse or semi-armour piercing high-explosive with impact/electromagnetic fuse

Length: 4ft 11in (1.50m)

Body diameter: 5.9in (0.15m)

Wing span: 1ft 1in (0.33m)

Range: approx 9,840-13,125ft (3,000-4,000m)

Development and Service

Under development since 1964, this missile is

described as a higher-performance, extended-range version of the KAM-3D, suitable for use against armoured vehicles on both land and water. It differs from the earlier missile in several important respects. It is, for example, launched from the tubular container in which it is transported and stored. In action, the container is placed on a launch and tracking unit, incorporating the firing mechanism, optical sight and missile check-out device. A booster fires briefly to eject the KAM-9 from the launch-tube. Then, at a safe distance, the sustainer fires to accelerate the missile to cruising speed. The operator has only to keep his optical sight aligned on the target. Deviations from the line-of-sight track to the target are sensed automatically and corrective signals are fed from a computer to the missile via the wire-guidance system. The launching system has two modes, direct and separate fire. Production of the KAM-9 began in 1979, with deployment by the JGSDF the same year.

Kangaroo (AS-3)

USSR

Air-to-surface strategic missile. In service.

Powered by: Unidentified turbojet engine

Airframe: Aeroplane configuration. Sweptback wings and tail unit, with vertical surfaces of rhomboid form. Nose air-intake

Guidance and Control: Aerodynamic control surfaces

Warhead: Nuclear

Length: 48ft 11in (14.9m)

Body diameter: 6ft 0.75in (1.85m)

Wing span: 30ft (9.15m)

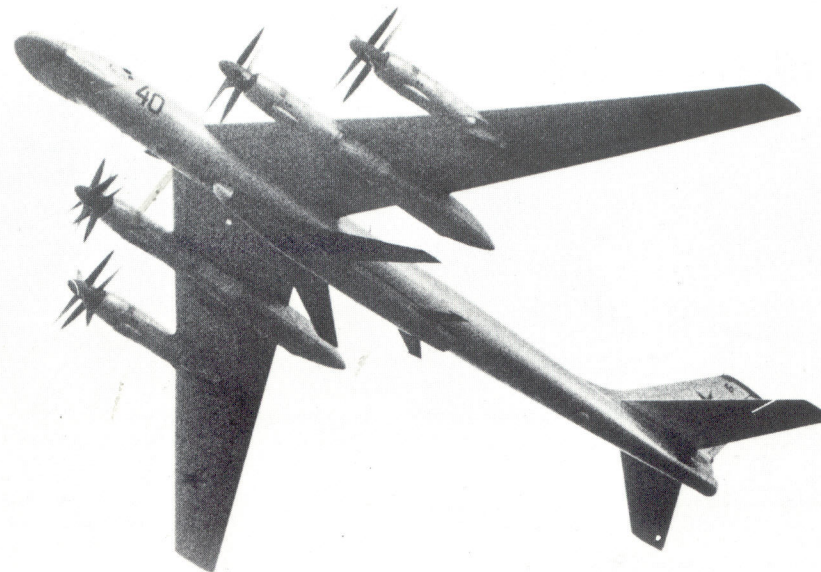
Launch weight: 24,250lb (11,000kg)

Speed: Mach 2

Max range: 400 miles (650km)

Development and Service

'Kangaroo' is similar in size and configuration to a single-seat, single-engined swept-wing fighter aircraft. It was first displayed, clamped under the cutaway bomb bay of its Tupolev Tu-95 'Bear' mother-plane, during the fly-past at the 1961 Soviet Aviation Day display at Tushino Airport, Moscow. Further details became available subsequently when a Soviet film showed a 'Kangaroo' being released from a Tu-95 in flight. In particular, the film showed the shape of the vertical tail surface for the first time, and confirmed that the ram air-intake of 'Kangaroo' is blanked off by a duct fairing under the Tu-95's belly in flight. This may convey compressed air from an auxiliary power unit to start the missile's engine before launch. A large radar scanner in the Tu-95's nose is probably used to compute the course to target, so that 'Kangaroo' can be directed initially on the correct compass bearing.



Kelt (AS-5)

USSR

Air-to-surface stand-off missile. In service.

Powered by: Unidentified type of rocket motor

Airframe: Aeroplane configuration, basically similar to that of 'Kennel', with sweptback wings and vertical tail surfaces. Rounded nose radome. Fairing under fuselage similar in form to that of 'Styx'

Guidance and Control: Possibly radar-homing.

Aerodynamic control surfaces

Length: 31ft 0in (9.45m)

Body diameter: 3ft 3.5in (1.00m)

Wing span: 15ft 0in (4.57m)

Cruising speed: Transonic

Range: over 100 miles (160km)

Development and Service

The underwing pylon on which 'Kelt' is carried by the Tu-16 'Badger' bomber appears to be more massive than that used for 'Kennel'. This suggests that 'Kelt'

is a heavier weapon than its turbojet-powered predecessor. It may also offer a higher degree of accuracy, as the ram-air intake and radome of the 'Kennel' are replaced by a hemispherical nose fairing thought to contain a larger radar. Published reports have implied that 'Kelt' is carried as a standard anti-shiping missile by Tu-16s of the Soviet Naval Air Arm, which operate over areas like the North Sea and Mediterranean. Twenty-five 'Kelts' are reported to have been launched from such aircraft, based in Egypt, during the October 1973 Arab-Israeli war. Twenty were claimed as destroyed by air and ground defences; the others hit two radar sites and a supply centre in Sinai. Considerably more than 1,000 'Kelts' are believed to have been delivered to the Soviet forces.

Below: 'Kelt' missiles carried by Tu-16 'Badger' bombers.



Kerry (AS-7)

Air-to-surface tactical missile. In service.

Guidance and Control: Probably radio command guidance

Launch weight: 2,650lb (1,200kg)

Range: 6.2 miles (10km)

USSR

Much smaller than any other Soviet air-to-surface guided missile yet identified, 'Kerry' is reported to be a tactical weapon carried by MiG-27, Su-17, Su-19 and Su-20 ground attack aircraft.

Kingfish (AS-6)

Air-to-surface stand-off missile. In service.

Powered by: Liquid-propellant rocket motor

Airframe: Cylindrical body with ogival nose, short-span wings and cruciform tail unit with a folding ventral fin

Guidance and Control: Inertial midcourse guidance. Active radar terminal homing

Warhead: Nuclear or possibly high-explosive

Length: 34ft 6in (10.50m)

Wing span: 8ft 2in (2.50m)

Cruising speed: Mach 3

Range: 135 miles (220km)

USSR

Development and Service

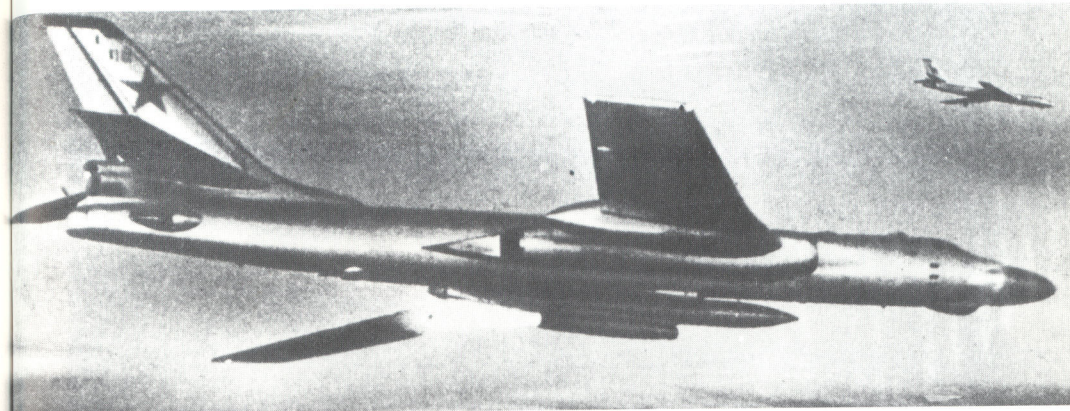
This very formidable and highly accurate missile is carried by Tu-16 'Badger' and Tu-26 'Backfire' bombers of the Soviet forces. It was first photographed in late 1977 while being carried by a Tu-16 near the coast of Japan. Reports have suggested that it is normally launched at an altitude of 36,000ft (11,000m), where it climbs to a greater height. Its warhead could be in the 200-kiloton yield range.

Below: 'Kingfish' missiles carried by a Tu-16 'Badger'.



Kipper (AS-2)

USSR



Air-to-surface stand-off missile. In service.

Powered by: Unidentified turbojet engine

Airframe: Aeroplane configuration, with cylindrical body, ogival nose-cone, mid-set sweptback wings and conventional sweptback tail surfaces. Engine slung under rear fuselage in pod

Guidance and Control: Probably radio command with active terminal homing

Warhead: Nuclear

Length: 31ft 0in (9.5m)

Body diameter: 2ft 11.5in (0.90m)

Wing span: 16ft (4.88m)

Launch weight: 9,260lb (4,200kg)

Cruising speed: Mach 1.2

Max range: 132 miles (213km)

Development and Service

Like 'Kangaroo' and 'Kitchen', this anti-shiping missile put in a surprise first appearance in the 1961

Above: 'Kipper' launch from a 'Badger-C'.

Soviet Aviation Day display at Tushino Airport, Moscow. It was seen to be similar in general configuration to the American Hound Dog, but smaller and of less refined form. 'Kipper' is carried by Tu-16 twin-jet bombers of the Soviet Naval Air Arm, clasped under the modified bomb-bay. This version of the Tu-16 is known to NATO as 'Badger-C', and has radar in a wide nose radome, presumably for detecting and fixing the position of the target before 'Kipper' is launched.

'Badger-Cs' have been reported over the North Sea and over the Mediterranean. 'Kipper' could clearly be used against targets on land as well as at sea.

Kitchen (AS-4)

USSR

Air-to-surface strategic missile. In service.

Powered by: Probably liquid-propellant rocket motor

Airframe: Aeroplane configuration. Basically-cylindrical body, with short-span delta wings and cruciform tail surfaces

Warhead: Nuclear

Length: 37ft 0in (11.3m)

Body diameter: 1ft 7.75in (0.50m)

Wing span: 8ft 0in (2.45m)

Launch weight: over 13,225lb (6,000kg)

Cruising speed: over Mach 2

Range: 185 miles (300km) at low altitude

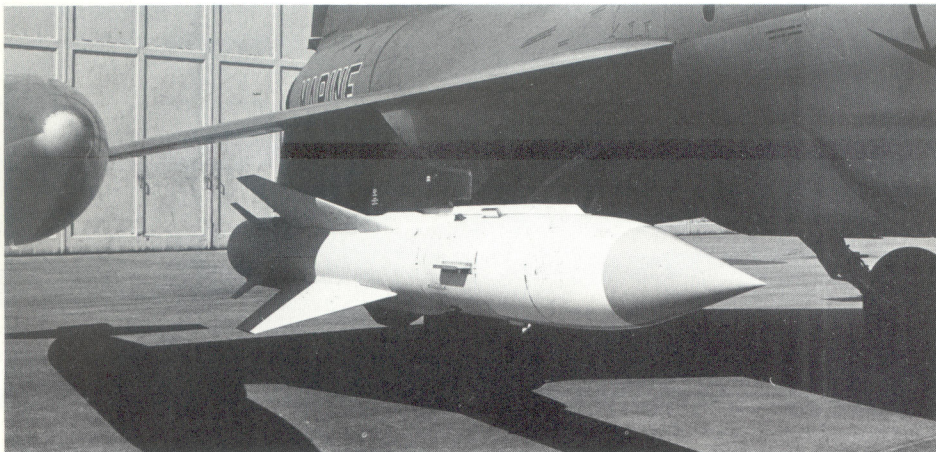
Development and Service

Although this weapon was first identified at the

1961 Soviet Aviation Day display, little is known about it. The commentator at Tushino Airport then referred to the Tu-22 'Blinder' carrying 'Kitchen' as the spearhead of the Soviet strategic rocket force, and most of the 22 Tu-22s which took part in the 1967 display at Domodedovo were armed with this missile. 'Kitchen', or a development of it, is also carried by the Tu-95 'Bear' and is one of the missiles that can be carried by the Tupolev Tu-26 'Backfire-B' swing-wing bomber which has followed the Tu-22 in Soviet Air Force and Navy service. About 1,000 'Kitchens' are believed to have been delivered by 1976.

Kormoran

Germany



Air-to-surface anti-ship missile. In production and service.

Prime contractor: Messerschmitt-Bölkow-Blohm GmbH

Powered by: Two built-in solid-propellant boosters; solid-propellant sustainer motor

Airframe: Cylindrical body with pointed nose-cone. Cruciform sweptback wings, indexed in line with cruciform tail control surfaces. Roll-stabilised

Guidance and Control: Inertial guidance system, with active or passive terminal homing by Thomson-CSF RE576 radar homing head. Control via tail surfaces

Warhead: High-explosive, weighing 352lb (160kg)
Length: 14ft 5in (4.40m)

Body diameter: 1ft 1.5in (0.342m)

Wing span: 3ft 3.5in (1.00m)

Launch weight: 1,320lb (600kg)

Max speed: Mach 0.95

Max range: 23 miles (37km)

Development and Service

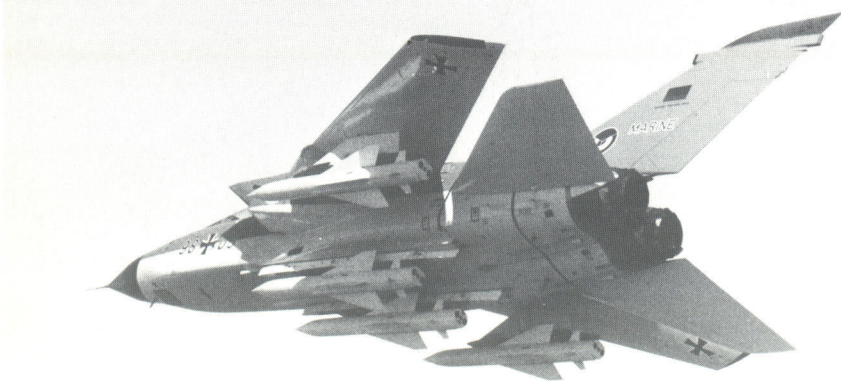
Largest postwar missile project undertaken in West Germany. Kormoran was developed to equip F-104G Starfighters and Tornados of the German Naval Air Service. Work on the weapon was started in 1964, as a collaborative programme by MBB and Nord-Aviation of France, who allocated the

designation AS.34 to the missile. This work was financed by the Federal German government and under the design leadership of MBB. It led to the first air launch from an F-104G on 19 March 1970. Tests of fully-equipped but inert missiles against targets many miles away from the launch aircraft began with equal success in early 1971. In-plant testing of the missile was completed early in 1974, at which time official tests on F-104Gs were being carried out. Initial production began in 1975, followed by full production in 1977 of 350 missiles and 56 aircraft installations.

Aircraft equipped with Kormoran must be fitted with an autonomous navigation system (such as Doppler or inertial), a position and homing indicator, and target detection radar. Launching is possible beyond the range of most anti-aircraft defence systems, and the aircraft can break away as soon as this has taken place. Kormoran is intended to be launched normally at low level, from an aircraft maintaining a speed between Mach 0.6 and 0.95, and travels towards the target at an altitude which puts it below shipboard radar cover. Its warhead can penetrate up to 3.5in (90mm) of steel plate and it is immune to all known forms of ECM.

Below: Tornado prototype carrying four Kormoran missiles.

Above right: Kormoran in final phase of attack.



Lance (MGM-52C)

USA

Surface-to-surface artillery missile. In production and service.

Prime contractor: Vought Corporation

Powered by: Rocketdyne dual-thrust storable liquid-propellant (UDMH and IRFNA) rocket engine

Airframe: Cylindrical body, with small cruciform tail-fins and ogival nose-cone

Guidance and Control: Simplified inertial guidance system, DC-Automet

Warhead: Alternative nuclear or high-explosive

types, including 450lb M234 and 1,000lb cluster warhead developed by Honeywell

Length: 20ft 2in (6.15m)

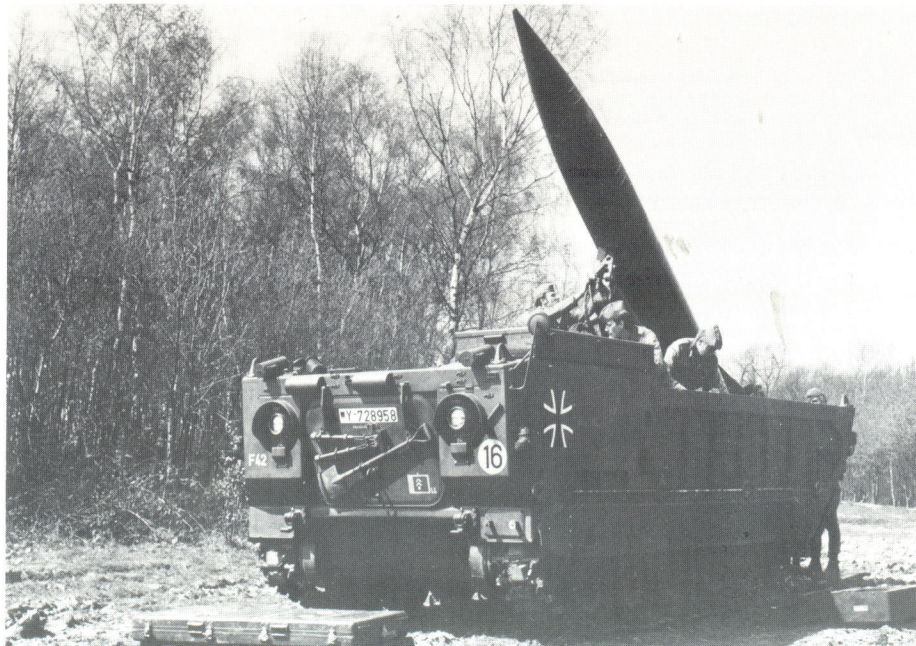
Body diameter: 1ft 10in (0.56m)

Launch weight: 2,834-3,368lb (1,286-1,528kg), depending upon warhead

Max speed: Mach 3

Max range: 75 miles (121km)

Below: Lance on a tracked launcher of the Federal German Army.





Development and Service

Known originally as Missile B, Lance has been under development since 1962 as a replacement for the US Army's Sergeant and Honest John. It is a divisional support weapon, intended to be transported normally on an M-752 tracked erector/launcher vehicle produced by FMC Corporation, with a further vehicle of the same type to carry two spare missiles and a reloading hoist. Alternatively, Lance can be fired from a lightweight wheeled launcher, produced by Orenda in Canada, which is helicopter-transportable. It requires an eight-man firing crew.

Firing trials began in March 1965, leading up to successful climatic trials in Alaska in 1969. Production was deferred to take advantage of improved performance offered by Extended Range Lance which is now the standard version. The Rocketdyne engine is interesting in that it consists of two concentrically-mounted stages. The high-thrust

Above: Lance on a lightweight wheeled launcher.

outer stage operates only as a launch booster and cuts out when the missile has reached its pre-determined velocity. The inner stage fires simultaneously, but continues operation as the sustainer, at reduced thrust, when the booster has burned out.

Lance production began under a US Army contract awarded in January 1971, with initial delivery of the complete weapon system for evaluation three months later. It has been operational since October 1973, and now serves with US Army units in Europe and the USA. Foreign purchasers include the British, Federal German, Belgian and Italian Armies. The Netherlands and Israel have ordered the version with a 1,000lb non-nuclear cluster warhead, the larger size of which limits range.

Lasso

Air-to-surface and surface-to-surface missile. Under development.

Prime contractor: Aérospatiale, Division Engins Tactiques

Airframe: Cylindrical body, with pointed nose and enlarged tail section. Cruciform wings

Guidance: Wire-guidance, using optical aiming/infra-red tracking system

Warhead: High-explosive, weighing 66lb (30kg)

Length: 6ft 10.75in (2.10m)

Body diameter: 8.75in (0.22m)

Wing span: 2ft 0.5in (0.62m)

Launch weight: 211lb (96kg)

Average cruising speed: 615mph (990km/h)

Range: 6.2-6.8 miles (10-11km)

Development and Service

Lasso is being developed as a private venture by Aérospatiale as a possible AS/SS.12 replacement, and its name is an acronym of Light Anti-Surface Semi-automatic Optical. Details of the missile were first given in 1978. It is a spin-stabilised missile and has been designed to be suitable for launching from helicopters, ships and shore batteries against surface targets. It is expected to offer a hit probability of more than 90% against small targets. Lasso's capability can be enhanced by adding a thermal imaging system to the sighting unit to allow night operations.

France

Luz 1

Air-to-surface missile. In production.

Prime contractor: Rafael Armament Development Authority and Israel Aircraft Industries

Guidance: Television-guided

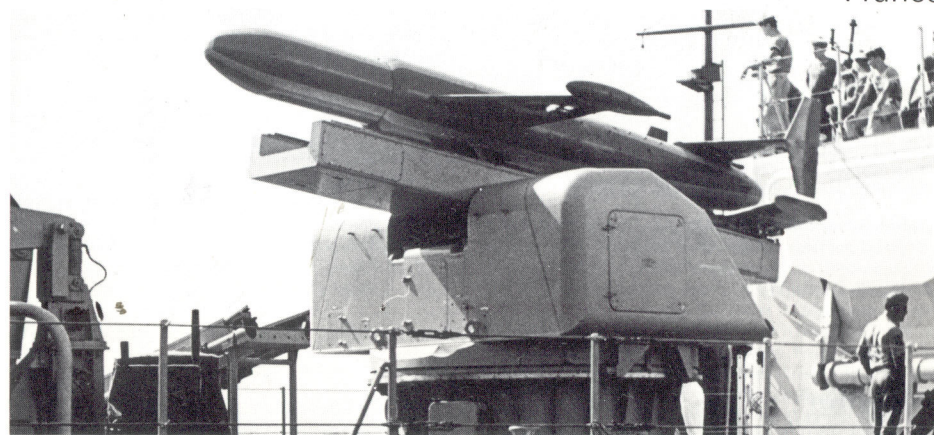
Launch weight: Possibly 441lb (200kg)

Range: 50 miles (80km)

Development and Service

In 1973 it was suggested that Israel was developing an air-to-surface TV-guided missile called Luz. This has since been confirmed, although no details have been officially released. Luz 1 will arm Kfir-C2s and Phantom F-4Es of the Israeli Air Force and preparation for this has already begun. It is said to be intended mainly for destroying surface-to-air weapon systems.

Malafon



Surface-to-surface or surface-to-underwater missile. In production and service.

Above: Malafon Mk 2 on board the French destroyer Vauquelin.

Prime contractor: Société Industrielle d'Aviation Latécoère

Powered by: Unpowered in cruising flight.

Launched by two SNPE Venus jettisonable solid-propellant boosters which burn for three seconds

Airframe: Aeroplane configuration. Cylindrical body, with tapered tail-cone and housing for torpedo in nose. Short pivoting wings. High-set tailplane with endplate fins. Wingtip tracking flares

Guidance and Control: Command guidance, via ship's sonar or radar, depending on submerged or surface target. 'Twist-and-steer' control by means of pivoting wings

Warhead: Acoustic-homing torpedo of 21in (53cm) diameter, weighing 1,157lb (525kg). This is ejected by inertia when a tail-parachute is streamed half-a-mile from the predicted position of the target

Length: 20ft 2.25in (6.15m)

Body diameter: 2ft 1.5in (0.65m)

Wing span: 10ft 10in (3.3m)

Launch weight: 3,305lb (1,500kg)

Max speed: 515mph (830km/h) at booster burn-out

Range: approx 1.2-8 miles (2-13km)

Development and Service

Development of this anti-submarine weapon system began in 1956. Initial launch trials, from the ground and from aircraft, underlined the problem of maintaining a correct cruising height after the launch-boosters had burned out. This was overcome eventually by using a radio altimeter to measure and maintain a constant altitude of about 330ft (100m) by changing the wing incidence to increase lift as the speed of the missile fell. Launch and guidance trials at sea began from the anti-submarine ship *La Galissonnière* in June 1962. The Operational sonar system and artillery-type radar were installed on this ship two years later, and operational testing of production Lat-233 Malafon Mk 2 missiles was undertaken in the first half of 1965. Subsequently, launchers have been installed on the frigates *Suffren* and *Duquesne* (each of which carries a single launcher and 13 missiles), five anti-submarine destroyers of the Type 47 Maille Brézé class, the destroyer *Aconit* and the three Type 67 Tourville class frigates.

Mamba

Portable anti-tank missile. In production and service.

Prime contractor: Messerschmitt-Bölkow-Blohm GmbH

Powered by: One-cell, dual-phase, oblique-thrust, solid-propellant rocket motor

Airframe: Cylindrical body with pointed conical nose. Large cruciform wings at rear of missile, each with a spoiler

Guidance and Control: Wire guidance by line-of-sight command, via operator's joystick controller. Control by spoilers in wings

Warhead: Shaped charge, weighing 6lb (2.7kg) and able to penetrate more than 18.7in (475mm) of steel armour. Alternative anti-tank shrapnel (ATS), able to penetrate 10in (250mm) of steel armour plus shrapnel spread, or training warheads

Length: 3ft 1.6in (0.955m)

Body diameter: 4.7in (0.12m)

Wing span: 1ft 3.7in (0.4m)

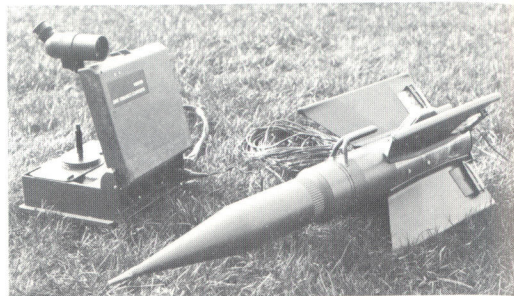
Launch weight: 24.7lb (11.2kg)

Max speed: 460ft (140m)/sec

Range limits: 985-6,560ft (300-2,000m)

Development and Service

Announced by MBB in 1972, Mamba is a development of the Cobra 2000. It is accelerated during flight from 35m/sec to a final speed of



140m/sec. This gives a flight duration of only 17.5 seconds over the full range. The initial low speed at close range gives the missile operator more time to react. Further help to the operator is given by the new x7 telescope and monocular eyepiece of the control unit, which allows the change from plain observation to telescope magnification without the operator moving his head.

The Mamba system comprises the missile and the control unit. The controller has four output sockets, for four missiles or three missiles and a junction box, which offers a total control capability of 11 missiles. Five Mambas can also be mounted on a vehicle frame if required.

Germany

Mariner

Surface-to-surface ship-launched missile. In production.

Prime contractor: Sistel-Sistemi Elettronici SpA

Total weight of system: 3,527lb (1,600kg)

The Mariner is the shipborne version of the helicopter-borne Marte anti-ship missile system, employing the same SMA radar and Sistel Sea Killer Mk 2 missiles.

This combination of equipment yields a lightweight, low cost, and effective anti-ship capability for fitting in fast patrol boats and similar

light craft in which the installation of heavy fire-control equipment and long-range missiles are not justified for reasons of cost, space, weight or generating capacity.

It also offers the possibility of Marte-equipped helicopters and Mariner-fitted surface craft co-operating effectively in combined operations in operational theatres where long-range missiles (guided by a homing radar installed on board the missile itself) cannot be employed.

Below: Mariner twin launcher on the stern of a missile boat.

Italy



Marte



Air-to-surface anti-shiping missile. Under development.

Prime contractor: Sistel-Sistemi Elettronici SpA

Guidance and Control: Guidance by radar or optical command, in conjunction with radar altimeter. Control by movable wings

Total weight of system: 2,568lb (1,165kg) on SH-3D

Range: 12.4 miles (20km)

Development and Service

The Marte weapon system has been developed to give shore- or ship-based helicopters an anti-shiping capability. Sistel's Sea Killer Mk 2 missiles were chosen for the system, with slight receiver modification, to be carried by Agusta-built Sikorsky SH-3D helicopters carrying a new chin-mounted SMA X-band track-while-scan radar. Studies have been made to confirm compatibility with a variety of other helicopters, with take-off weights ranging from 6,600 to 22,050lb (3,000-10,000kg). The equipment fitted to a Marte helicopter is lightweight

Above: Marte launched from an SH-3D helicopter.

and easy to operate, being based on a radar which performs navigation, search and target tracking, and azimuth guidance of the missile.

In operation, after the target has been located by the helicopter's radar, the radar is switched off and the helicopter descends so that it can approach its target at the lowest practicable height above the water. At a distance from the target estimated as being just outside the missile range, the helicopter climbs to launching altitude, re-acquires the target and fires the Sea Killer missile. A radar altimeter in the missile keeps it at very low altitude above the water, although altitude can be altered during flight by command signal. Azimuth control is either by automatic radar mode or by a secondary fair-weather system, using optical sight and joystick controller.

Air and ground launches of the Marte weapon system have continued. The Italian Navy has placed a pre-production contract for SH-3D installations, each comprising two missiles, launch-equipment, sonar and optical sight.

Martel (AS.37/AJ.168)

Air-to-surface missile. In service.

Prime contractors: SA des Engins Matra (France) and British Aerospace Dynamics Group (UK)

Powered by: Solid-propellant rocket motors by Hotchkiss-Brandt and Aérospatiale

Airframe: Cylindrical body, with sweptback cruciform wings, indexed in line with cruciform tail control surfaces. AJ.168 version has a hemispherical glass nose; the AS.37 has a pointed ogival nose

Guidance and Control: AS.37 homes automatically on emissions from enemy radars.

France/UK

AJ.168 follows a pre-programmed course initially. Final impact is effected by the weapon operator, who is given a visual picture of the target area on a high-brightness monitor by means of a TV camera in the nose of the missile. By movement of a joystick or similar control in the cockpit of the launch aircraft, the operator aligns the TV camera on target. The missile control system then causes the Martel to align its axis with that of the TV camera. Control via tail-fins

Warhead: High-explosive, weighing 330lb (150kg), with proximity fuse



Length: AS.37 13ft 6.25in (4.12m)
AJ.168 12ft 8.5in (3.87m)
Body diameter: 1ft 3.75in (0.40m)
Wing span: 3ft 11.25in (1.20m)
Launch weight: AS.37 1,168lb (530kg)
AJ.168 1,213lb (550kg)
Performance: Subsonic
Range: AS.37 18.5 miles (30km)

Development and Service

This very important tactical missile was developed in two forms for the RAF and French Services. Prototypes of both versions were completed in 1965-66 and development was completed, after highly successful test firings, in 1968. Evaluation started in 1969 and delivery of production Martels

Above: Martel anti-radar (left) and TV-guided missiles under the wing of a Buccaneer.

began in 1972. The AJ.168, carried by the RAF's Buccaneer aircraft, is a command guided weapon for stand-off attacks on surface targets and is described as having a range of 'tens of miles'. The AS.37 is an all-weather weapon for the specific task of destroying enemy radars, on which it homes automatically after launch at very low, medium or high altitudes. In other respects the two versions are identical, and both are able to operate regardless of enemy electronic countermeasures (ECM) activity. The AS.37 arms a variety of aircraft, including Mirage III-E, Jaguar and Atlantic aircraft of the French Air Force and Navy, and British Buccaneers.

Masurca MQ2

Ship-based surface-to-air missile. In service.

Prime contractor: Direction Technique des Constructions Navales

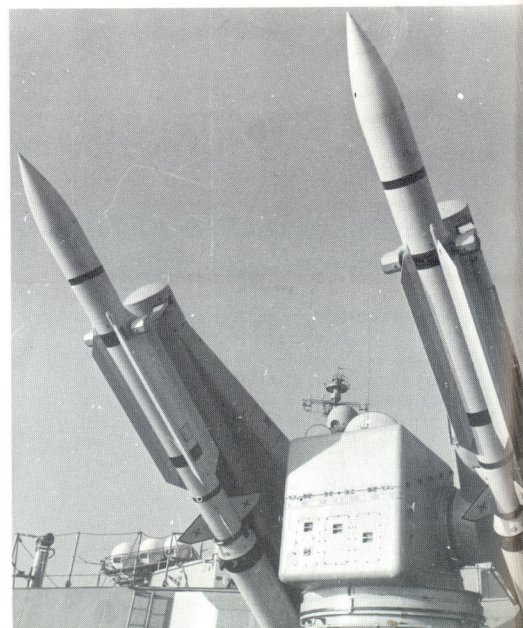
Powered by: Tandem two-stage solid-propellant rocket motors supplied by the Société Nationale des Poudres et Explosifs (SNPE).

Polka booster develops 75,000lb (34,000kg) st Second stage develops 4,585lb (2,080kg) st in the Mod 2 missile, 4,785lb (2,170kg) st in the Mod 3

Airframe: Tandem two-stage missile. Cylindrical missile body with pointed ogival nose; cruciform wings of long chord and constant narrow span, indexed in line with pivoted cruciform tail control surfaces. Cylindrical jettisonable booster of larger diameter than missile, with cruciform tail-fins indexed in line with those of missile

Guidance and Control: Mod 2 version has beam-riding guidance and Mod 3 has semi-active radar homing, in each case by Thomson-CSF. Control by tail surfaces

Warhead: High-explosive, weighing 105lb (48kg), with proximity fuse



France

Length: 28ft 2.5in (8.60m) with booster
17ft 4.5in (5.29m) without booster
Body diameter: 1ft 4in (0.406m)
Wing span: 2ft 6in (0.77m)
Launch weight: Mod 2 4,080lb (1,850kg)
Mod 3 4,585lb (2,080kg)
Max range: Mod 2 24.9 miles (40km)
Mod 3 31 miles (50km)

Development and Service

Developed and produced by the Etablissement des Constructions et Armes Navales de Ruelle (ECAN de

Ruelle), this anti-aircraft missile is carried on a twin-launcher by the French Navy frigates *Suffren* and *Duquesne*, whose main duty is to provide escort for the carriers *Foch* and *Clémenceau*. A similar launcher is carried by the cruiser *Colbert* following an extensive refit. Two missiles can be launched in a space of a few seconds against different targets. Each ship carries a total of 48 missiles.

Although there are two versions of the missile, with different guidance systems, they are virtually identical externally and a ship's twin launcher can fire a similar or mixed pair of missiles simultaneously.

Maverick (AGM-65)

USA

Tactical air-to-surface missile. In production and service.

Data: AGM-65A

Prime contractor: Hughes Aircraft Company

Powered by: Thiokol TX-481 solid-propellant rocket motor

Airframe: Cylindrical body, with rounded nose. Long-chord delta wings, indexed in line with cruciform tail control surfaces, mounted close to their trailing-edges

Guidance and Control: Self-homing TV (AGM-65A/B), laser (AGM-65C) and imaging infra-red (AGM-65D) guidance systems. Control via tail fins

Warhead: Shaped charge weighing 130lb (59kg) with AGM-65A/B/D; selectable delay blast frag penetrator weighing 290lb (132kg) with AGM-65C/D

Length: 8ft 1in (2.46m)

Body diameter: 1ft 0in (0.30m)

Wing span: 2ft 4in (0.71m)

Launch weight: 462lb (210kg) with shaped charge warhead; 630lb (286kg) with blast frag penetrator warhead.

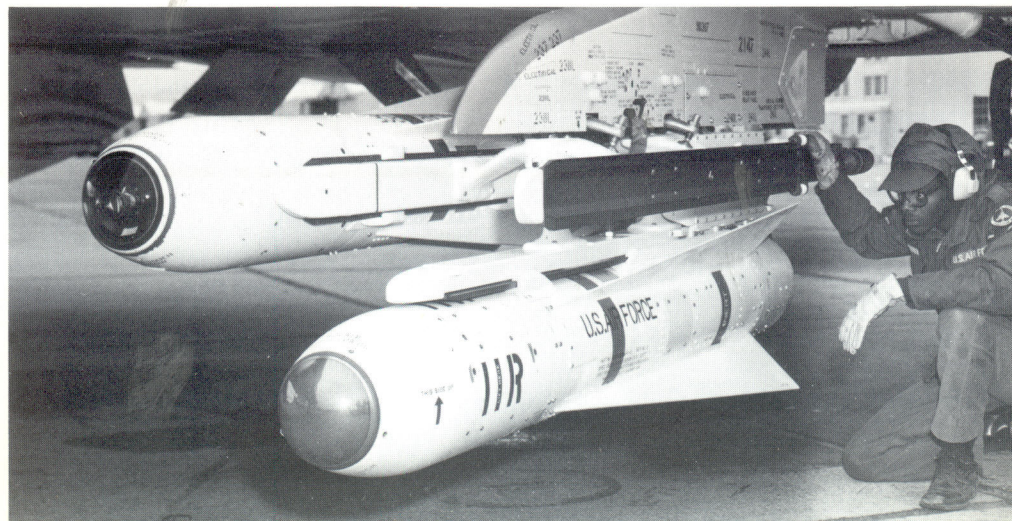
Performance: Secret, but range thought to be about 14 miles (22km)

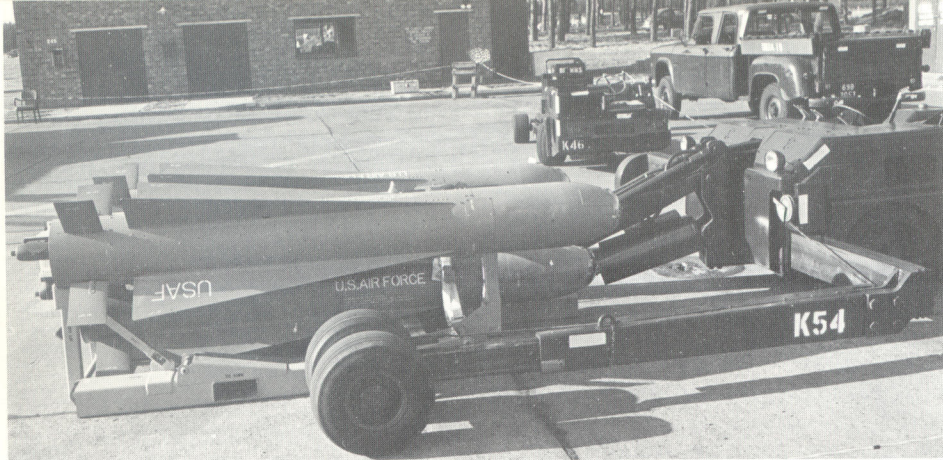
Development and Service

Maverick is intended for use against a variety of targets such as tanks, field fortifications, radar sites, ships, command bunkers and airfields. Its development began in July 1968, under contract from the USAF Aeronautical Systems Division, to provide a 'launch and leave' missile. More than 200 performance launches of TV Maverick resulted in 92.2% direct hits. Reliability of more than 96% has been experienced, which verifies the 10-year shelf 'wooden round' maintenance concept. Deliveries of the initial AGM-65A TV-guided version began in August 1972.

Operational use of TV Maverick by the Israeli Air Force during the Yom Kippur war, in October 1973, produced results described as 'the most successful weapon of the war'. Further versions of Maverick have been developed to improve the missile's versatility. The operational AGM-65B has a 'scene magnification' TV seeker, enabling the pilot to identify and lock on to the target at longer range, or to attack smaller targets. The AGM-65C uses laser guidance, in conjunction with an air or ground target designator, enabling it to be fired by day or night. Flight testing of the AGM-65C began in 1979, and

Below: Maverick with new imaging infra-red seeker (lower).





this version is expected to go into service with the USMC. The AGM-65D is another day or night adverse weather version, with an imaging infra-red (IIR) seeker which produces an image on a screen by sensing small differences in heat radiated by objects viewed. Flight testing will begin in spring 1980 and

Above: AGM-65A Mavericks with TV guidance.

production for the USAF could begin in 1983. A large new penetrator warhead to arm Maverick is also under development.

MD-660 (Jericho) and Ze'ev

Surface-to-surface bombardment missile.

Prime contractor: Israel Aircraft Industries Ltd
Powered by: Solid-propellant motors
Airframe: Two-stage missile
Warhead: Probably alternative nuclear or high-explosive
Airframe, Dimensions and Weights: Secret
Max range: 280 miles (450km)

Development and Service

No details have come officially from Israeli sources to confirm reports of the existence of this mobile, ramp-launched weapon. The fact remains that Israel possesses the capability of manufacturing nuclear warheads at the Dimona reactor centre near the Dead Sea.

MILAN



Israel

The designation MD-660 implies that the early development of this missile system was undertaken by Avions Marcel Dassault of France on behalf of the Israeli Government; and sea trials of a weapon named Jericho were reported to be taking place in the Mediterranean, off Toulon, in the Spring of 1968. Whether or not Jericho is related to the MD-660 cannot be verified and, anyway, may not exist as an operational weapon. Reports have indicated the possible existence of another Israeli battlefield weapon known as Ze'ev (Wolf). It is said to exist in two forms, the first carrying a 352lb (160kg) warhead over a range of just 1,000m, and the second carrying a 154lb (70kg) warhead over 4,500m. These reports cannot be verified.

France/Germany

Infantry anti-tank missile. In production and service.

Prime contractor: Euromissile (Aérospatiale, Division Engins Tactiques/Messerschmitt-Bölkow-Blohm GmbH)
Powered by: Ejected from launch tube by booster charge. Dual-thrust solid-propellant sustainer rocket motor
Airframe: Basically cylindrical body, with fore and aft sections of larger diameter than centre portion. Four flip-out tail-fins
Guidance and Control: Wire guidance, using TCA optical aiming/infra-red tracking system. Spin-stabilised by tail-fins. Control by jet-deflection
Warhead: Hollow charge
Length: 2ft 5.5in (0.755m)
Body diameter: 4.6in (0.116m)
Fin span: 10.5in (0.266m)
Launch weight: 14.8lb (6.7kg)
Max speed: 447mph (720km/h)
Range limits: 83-6,560ft (25-2,000m)

Development and Service

MILAN (Missile d'Infanterie Léger ANti-tank) is one of three modern-generation battlefield weapon systems developed jointly by Aérospatiale and MBB, the others being HOT and Roland. It is typical of many current missiles in being fired from its transport container, which is simply placed on a lightweight launch and guidance unit when required for use. The latter unit embodies the firing mechanism, an optical sight with $\times 7$ magnification, an infra-red goniometer and the guidance electronics. One man can carry the complete weapon system, accompanied by a colleague carrying two spare missiles. It can also be used from any type of vehicle without modification of the system, and is already mounted on the German Kraka truck and will be mounted on the French VAB Front Armoured Vehicle (Véhicule de Combat Anti-char version).

Compared with the missiles it replaces, MILAN is a high-speed weapon, reducing the opportunity for effective counter-fire from the target. Its initial velocity of 75m/sec is increased to 130m/sec during



boost phase, and to 200m/sec in sustainer phase. Guidance is by the TCA system. Once the operator has acquired the target visually, he tracks it and fires the missile. His sight is linked to an infra-red missile tracking system and electronics equipment which processes the data and transmits command signals to the missile to keep in on the line-of-sight course to the target.

Over short ranges, MILAN can be used as a rocket launcher, and claims have been made for its effectiveness as a surface-to-air weapon to protect ground targets against head-on attack by helicopters and low-flying fixed-wing aircraft. Development testing of the basic weapon system was completed by 1971. Initial orders for 22,000 missiles and 800 launchers were made for the French and German armies. By mid-1978, orders had been raised to over 76,000 missiles and 3,000 launchers, to arm the forces of nearly 20 countries. MILAN will also be licence-built in the UK for the British Army, following on the delivery of the Euromissile-built missiles, which are now in service. A thermal imaging system has been developed to give the missile night-firing capability. The system is expected to enter service in 1981.

Minuteman (LGM-30)

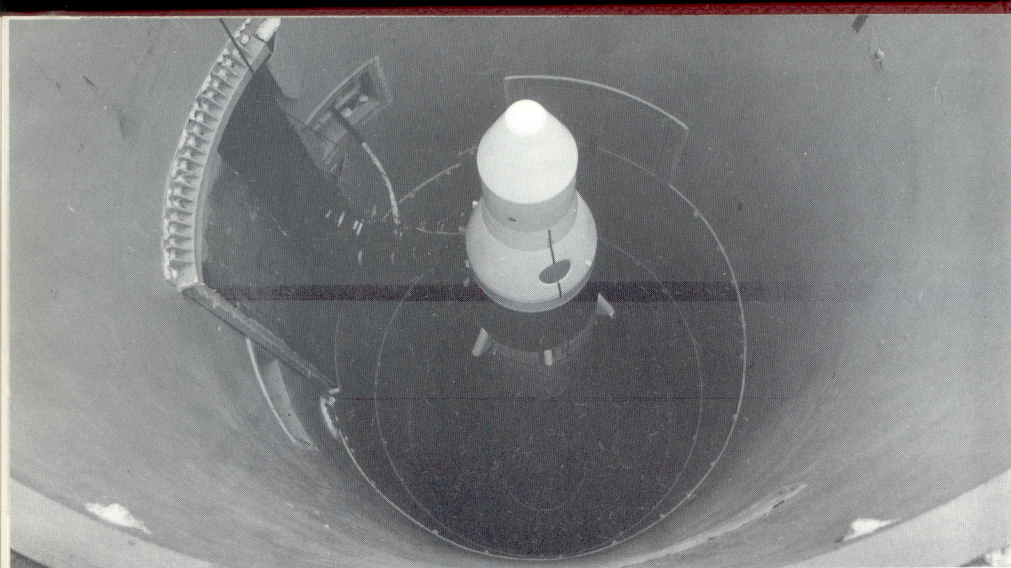
Intercontinental ballistic missile. In service.

Data: LGM-30G Minuteman III
Prime contractor: Boeing Aerospace Company
Powered by: First stage Thiokol M-55E solid-propellant motor of approx 200,600lb (91,000kg) thrust
 Second stage Aerojet SR19-AJ-1 of 60,030lb (27,500kg) thrust
 Third stage Aerojet/Thiokol SR73-AJ-1 of 34,170lb (15,500kg) thrust
Airframe: Three-stage cylindrical missile. Two

Right: Minuteman III launch.



USA



Above: Minuteman II in its silo.

upper stages have smaller diameter than first stage. Ogival nose fairing covers warhead. No fins or wings
Guidance and Control: Inertial guidance system by Autonetics Division of Rockwell International. First stage control by four swivelling nozzles. Second and third stages controlled by fluid injection into single nozzle

Warhead: Thermonuclear, in multiple individually-targetable re-entry vehicles (MIRV)

Length: 59ft 10in (18.20m)

Max body diameter: 6ft 0in (1.83m)

Launch weight: 76,000lb (34,475kg)

Max speed: 15,000mph (24,000km/h)

Max range: over 8,075 miles (13,000km)

Development and Service

Minuteman was designed as a second-generation ICBM to supersede the earlier liquid-propellant Atlas and Titan. Its solid-propellant motors enable it to be stored at instant readiness in below-ground silo launchers. Although much smaller and lighter in weight than the first-generation weapons, its range is similar. The warhead is smaller, but the use of MIRV warheads of Minuteman III increases enormously the possibility of penetrating enemy defence systems.

Two versions of Minuteman are currently operational. Wings I at Malmstrom AFB, Montana, IV at Whiteman AFB, Missouri, and VI at Grand Forks, Utah, have LGM-30F Minuteman IIs, 59ft 10in (18.20m) long, with a weight of 70,000lb

(31,750kg) and range of 7,000 miles (11,265km). Each successive stage is smaller than the one before, with a still-smaller cylindrical warhead of two megatons in an Avco Type II B/C re-entry vehicle. Minuteman IIIs equip Wing II at Ellsworth AFB, South Dakota, Wing III at Minot AFB, N Dakota, and Wing V at Warren AFB, Wyoming. These are similar in length to Minuteman IIs but weigh 76,000lb (34,475kg) and have a range of over 8,075 miles (13,000km). The force comprises 450 LGM-30Fs and 550 LGM-30Gs.

The 200 silo launchers of Wing 1 are dispersed over an area of 18,000 sq miles (46,600km²). Each silo is 80ft (24.4m) deep. Two Strategic Air Command officers control each flight of 10 missiles from an underground launch centre. Airborne control can be exercised from KC-135 command post aircraft.

In a programme designed to enhance the capability of the Minuteman force, the new Mk 12A re-entry vehicle has been developed to replace the current Mk 12 in some Minuteman IIIs. The Mk 12A has three 350KT yield warheads instead of three 200KT warheads in the Mk 12, and has miniaturised arming and firing systems. Silos have also been upgraded.

Minuteman is no longer in production, the final missile being delivered on 30 November 1978.

Switzerland/Italy

Airframe: Cylindrical glass-fibre body with pointed conical nose. Folding cruciform wings of sandwich construction, each with trailing-edge vibrating spoiler

Guidance and Control: Wire guidance by command to line-of-sight, with roll-stabilisation by



powder-driven gyro. Control by vibrating spoilers on wings

Warhead: Hollow charge, weighing 9lb (4kg) and able to penetrate more than 26in (660mm) of armour, or fragmentation type

Length: 3ft 7.7in (1.11m)

Body diameter: 4.72in (0.12m)

Wing span: 1ft 11.6in (0.60m)

Launch weight: 31lb (14.1kg)

Cruising speed: 205mph (330km/h)

Range limits: 1,200-7,800ft (360-2,375m)

Development and Service

This simple, one-man, infantry anti-tank weapon was developed by Contraves-Oerlikon of Switzerland but

manufactured by Contraves Italiana. It is standard equipment in the Swiss and Italian Armies, who use also a version fitted with a parachute recovery system, instead of a warhead, for training. Six Mosquitos can be carried in their container-launchers, ready for firing, by the Puch-Haflinger light cross-country vehicle. Mosquitos have also been fired successfully from Agusta-Bell 47 helicopters.

In conventional infantry use, the Mosquito is controlled and fired by means of a small control box carrying a joystick and optical sight. The container-launcher houses the missile with its warhead detached and weighs 48.5lb (22.0kg).

MSBS (M-2 and M-20)

Submarine-launched ballistic missile. In production and service.

Prime contractor: Aérospatiale, Division Systèmes Balistiques et Spatiaux

Powered by: First stage SEP P.10 (Type 904)

solid-propellant motor

Second stage SEP P.6 (Rita II) solid-propellant motor

Guidance and Control: Inertial guidance. Control

by four gimbaled nozzles in first stage: Freon

injection into single fixed nozzle in second stage

Warhead: M-2 Nuclear, approx 500-kiloton yield

M-20 Thermonuclear, 1 megaton yield

Length: 34ft 0in (10.36m)

Body diameter: 4ft 11in (1.50m)

Launch weight: M-20 44,120lb (20,012kg)

Max range: 1,864 miles (3,000km)

Development and Service

The M-2 improved version of the MSBS became operational in the French Navy's third SNLE submarine *Foudroyant* in 1974. The submarines *Terrible* and *Redoutable*, then fitted with M-1s, have since been installed with M-4s and M-2s respectively.

In 1976, the M-20 missile entered service. Although essentially an M-2, it incorporates a new hardened re-entry vehicle system protected by fairings to improve its chances against anti-ballistic missile nuclear attack, and has a megaton strength thermonuclear payload and new penetration aids. First installed in *Indomptable*, France's fourth SNLE submarine, it is now also installed in *Tonnant*, the fifth SNLE submarine.

France



Above: MSBS M-20 launch.

Mosquito

Lightweight anti-tank missile. In service.

Prime contractor: Contraves Italiana SpA

Powered by: Two-stage solid-propellant rocket motor

MSBS (M-4)

Submarine-launched ballistic missile. Under development.

Prime contractor: Aérospatiale, Division Systèmes Balistiques et Spatiaux

Powered by: First stage 401 solid-propellant motor
Second stage 402
Third stage 403

Guidance and Control: Inertial guidance. Control of each of the three stages by single flexible nozzle

Warhead: Thermonuclear, in multiple re-entry vehicles

Length: 36ft 3in (11.05m)

Body diameter: 6ft 4in (1.93m)

Max range: 2,485 miles (4,000km)

Development and Service

The MSBS M-4 is a completely new submarine-

launched ballistic missile. Its main differences compared with the earlier M-20 are that it has three stages, multiple re-entry vehicles and new motors. However, the M-4 can be launched from existing SNLE submarines after some modifications in the tubes.

The development phase of the M-4 programme began in April 1976. The second SNLE submarine *Terrible* is currently being installed with M-4s, although operational deployment of the new system is not expected until the mid-1980s. The sixth SNLE submarine, *Inflexible*, will be fitted with M-4s.

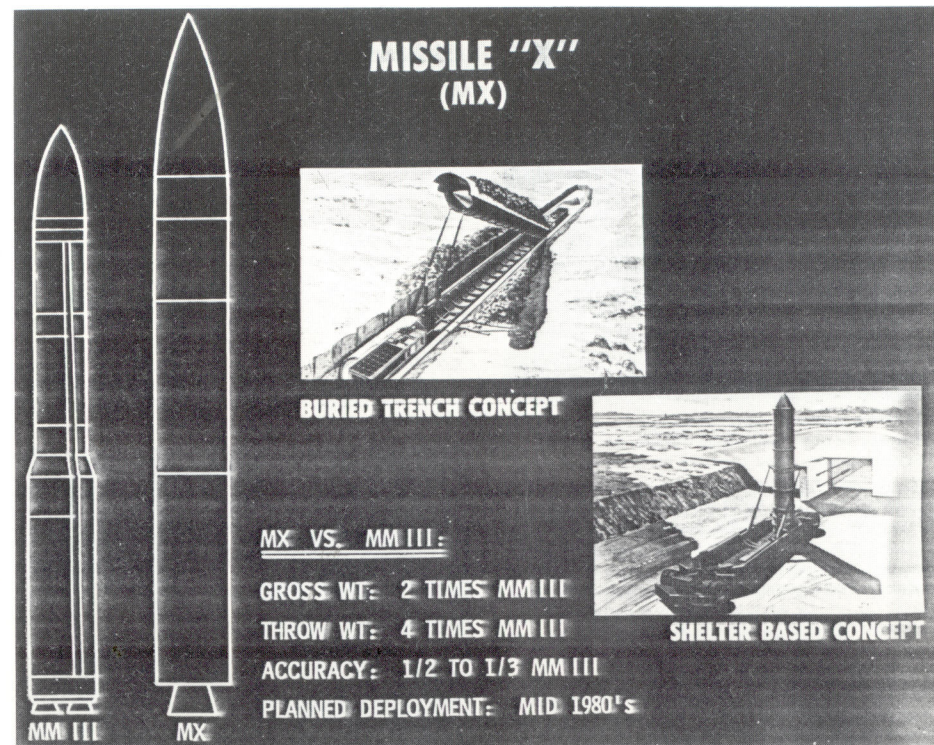
Below: (Left to right) MSBS M-1, M-4, SSBS S-3 and S-2.



France

M-X

USA



Advanced intercontinental ballistic missile. Under development

Development and Service

The M-X intercontinental ballistic missile programme began in 1974, when it was apparent that a Minuteman replacement would be needed in the 1980s if the USA was to continue to deploy a realistic deterrent force in the face of the latest Soviet missiles being deployed and those currently under development, which not only have a massive increase in throw weight but threaten conventional hardened silo bases. The M-X programme will provide the technology to build a new missile with a greater throw-weight than Minuteman III, improved accuracy and one that will be based either in a long trench with hardened areas, a shelter concept or on a

Above: Artist's impression of the M-X buried trench and shelter based concepts, plus comparative size with Minuteman III missile.

mobile vehicle. However, the USAF favours the trench mode and test trenches have already been dug for evaluation of erection equipment, although the shelter concept is considered a suitable back-up. It seems probable that about 200 missiles will be built if the programme is allowed to continue. Already the M-X programme has been delayed, despite the acceptance in the USA that existing silo-based missiles are vulnerable to attack. If no further delays are incurred, flight testing of the missile could begin in 1984.

Naval Crotale

Ship-based surface-to-air close-range weapon system. In production and service.

Prime contractor: Thomson-CSF

Development and Service

Matra's Crotale all-weather surface-to-air weapon system offered such promise that Thomson-CSF decided to develop a ship-based version as a private venture. The result was first called Murene, but later

France

changed to Naval Crotale. It comprises one or more eight-round turret-launchers, a DRBV 26 surveillance radar, a DRBV 51 radar to acquire the target and IFF interrogation, stabilised fire control radar, a digital computer for automatic tracking and a display console. The missile can be launched by the single operator from his hardened fire control room shelter or from the central operations room. This version of Crotale has been selected by the French Navy for use

Nike Hercules (MIM-14B)

Surface-to-air missile. In service

Prime contractors: Western Electric Company Inc/Mitsubishi Heavy Industries Ltd

Powered by: Thiokol solid-propellant sustainer. Hercules Inc clustered four-motor solid-propellant jettisonable booster

Airframe: Tandem two-stage missile. Basically-cylindrical missile body, tapering towards nose which carries small cruciform delta surfaces. Long-chord cruciform delta wings, each with trailing-edge control surface. Booster is made up of four cylindrical motors with cruciform stabilising fins indexed in line with missile wings.

Guidance and Control: Western Electric command system. Control by wing trailing-edge surfaces

Warhead: Alternative nuclear or high-explosive types

Length: 39ft 8in (12.10m)

Max body diameter: 2ft 7.5in (0.80m)

Wing span: 6ft 2in (1.88m)

Launch weight: 10,710lb (4,858kg)

Max speed: Mach 3.65

Max range: 87 miles (140km)

Effective ceiling: 28 miles (45km)

Development and Service

Although development of Nike Hercules was started as long ago as 1953, to replace Nike Ajax, it remained in production by Mitsubishi in Japan until recently. In the USA, where it became operational as the nation's primary anti-aircraft defence weapon in 1958, the number of launch-sites has been reduced progressively, and in 1974 it was decided to close all but two Nike Hercules battalions in the United States by the end of that year. The remaining battalions are based in Southern Florida and the Anchorage area of Alaska.

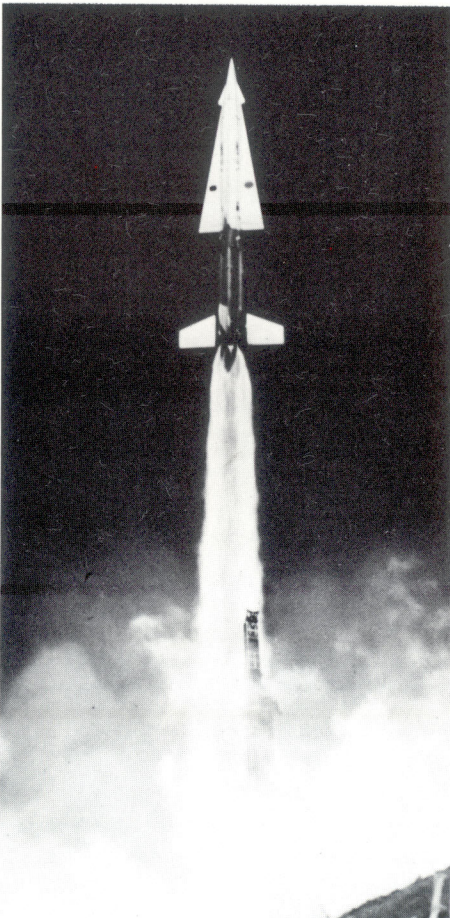
The Nike Hercules missile was developed and produced originally by the Douglas Aircraft Company, and achieved a notable early success when one Nike Hercules intercepted another at a range of 30 miles (48km) from its launch-point, and altitude of about 100,000ft (30,500m) over White Sands Missile Range in September 1960.

In operation, the target is acquired first by acquisition radars, which pass it on to the target tracking radar. When the missile is launched, another tracking radar issues command guidance and detonation instructions under the control of the weapon system's data processing equipment. In the

aboard its ships and by at least one other navy. Firing trials began in March 1978 on board *Ile d'Oleron*, and these were followed by trials on board the destroyer *Georges Leygues*, which was the first operational vessel with Naval Crotale. The missile now also arms Tourville class frigates, *Jeanne d'Arc* helicopter cruiser and will arm all new Georges Leygues class C70 destroyers and the PH75 nuclear-powered helicopter carrier.

USA

USA, Nike Hercules batteries were integrated into the SAGE defence system, which controlled all air defence fighters and missiles. Nike Hercules is also operational in a mobile role, notably with NATO and friendly countries, using a HIPAR advanced high-power acquisition radar which greatly increases the mobility and detection capability.



Otomat

Anti-shipping missile. In production and service.

Prime contractors: SA Matra (France) and Oto Melara SpA (Italy)

Powered by: Turboméca Arbizon II turbojet, rated at 882lb (400kg) st. Two side-mounted jettisonable boosters

Airframe: Cylindrical body. Four semi-circular engine air-intake ducts, each supporting a cropped-delta wing, equi-spaced around body mid-way between nose and tail. Cruciform tail control surfaces indexed in line with wings. Ogival nose-cone and tapered tail fairing

Guidance and Control: Inertial guidance, with Thomson-CSF active radar terminal homing. Tail control surfaces

Warhead: Semi-armour piercing type, weighing 460lb (210kg)

Length: 14ft 5.25in (4.40m)

Body diameter: 1ft 3.75in (0.40m) forward of ducts

Wing span: 3ft 10.75in (1.19m)

Launch weight: 1,543lb (700kg)

Max speed: Mach 0.9

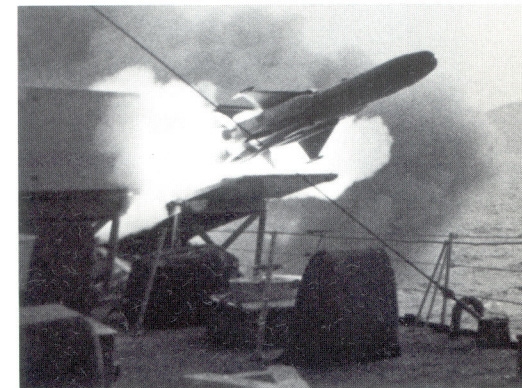
Max range: 112 miles (180km)

Development and Service

This missile takes its name from those of its manufacturers, *Oto Melara* and *Matra*. Its development was started in 1969, to provide a weapon in the same category as the French Exocet, but with a much longer range as a result of its use of a turbojet engine instead of a rocket motor. The warhead is unusually large and its effects are increased by the incendiary effect of any fuel remaining in the missile when it strikes the target.

Otomat does not require a swivelling launcher. It can be mounted in a fixed position on the launching craft, inside its delivery container which doubles as launcher. Firing is possible in all weathers, by day or night, and the missile is able to change direction up to 180 degrees, to port or starboard, to align itself on the target, which can therefore be behind the launch-ship. The basic course to the target is worked

France/Italy



Above: Ship-launched Otomat.

out by the shipboard radar and fire control system, with radar terminal homing on enemy ships that can be well 'over the horizon' and hence beyond the range of the ship's radar. A radio altimeter maintains a cruising height of about 80ft (25m) throughout the missile's flight, with a final attack either from low level or at the end of a steep dive after a climb started 4.35 miles (7km) from the target.

Otomat has been produced in two versions: ship-to-ship and for coastal defence. Both versions are characterised by a very long range. An air-to-sea version is under study. It has been chosen by several foreign navies, totalling about 400 missiles, to arm about 30 ships of various sizes ranging from hydrofoil patrol boats to corvettes and helicopter-carrying frigates.

The first firing of a complete missile was on 28 February 1972, at Salto Di Quirra range in Sardinia. In June 1974, the Italian Navy hydrofoil boat *Sparviero* launched its first Otomat. Within the framework of the production plan, four missiles were launched in 1978 at the Salto Di Quirra range. The complete Otomat system is in series production.

P3T

Air-to-surface missile. Under development

Prime contractor: British Aerospace Dynamics Group

Powered by: Microturbo TRI-60 turbojet engine

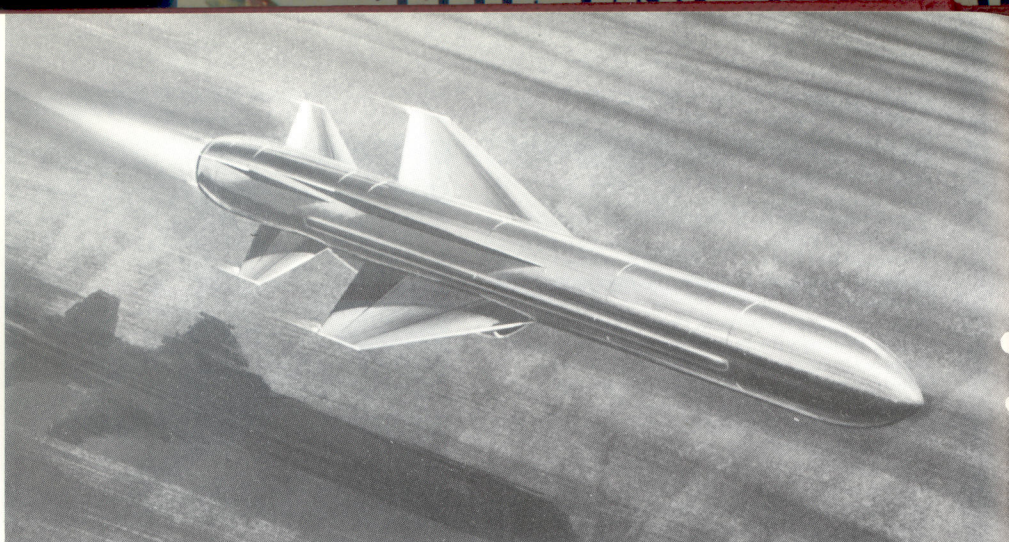
Airframe: Cylindrical body, with sweptback cruciform wings, indexed in line with cruciform tail control surfaces. Ogival nose

Guidance and Control: Active radar guidance. Control via tail-fins

UK

Development and Service

In August 1977, the British Minister of State for Defence announced that development was to be undertaken of a second generation air-launched sea-skimming anti-ship missile to replace the Martel with the RAF in the early 1980s. It will eventually arm RAF Buccaneers and Panavia Tornado GR Mk 1s and Royal Navy Sea Harriers. The P3T is an all-weather missile with fire-and-forget capability, which has been designed to be launched out of range of the target ship's surface-to-air defences and operate successfully against multiple targets in an electronic countermeasures environment.



Above: Artist's impression of the P3T.

Patriot (XMIM-104)

Surface-to-air weapon system. Under development.

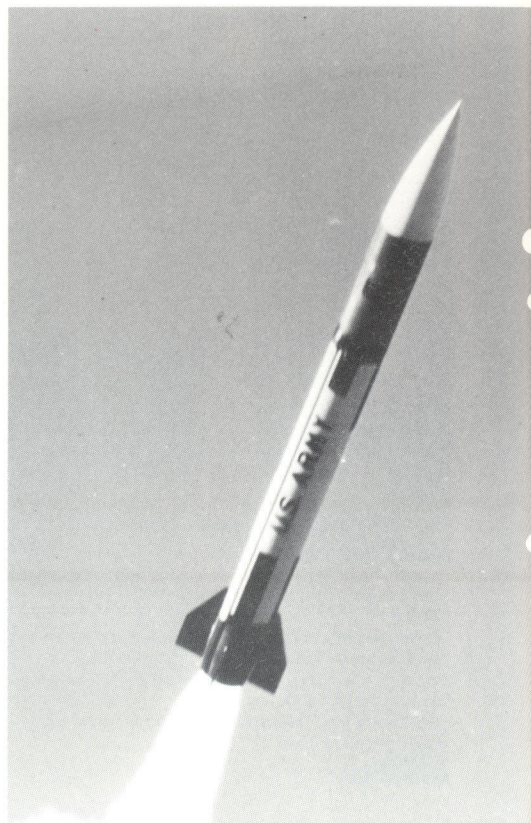
Prime contractor: Raytheon Company
Powered by: Thiokol TX-486 single-stage solid-propellant rocket motor
Airframe: Cylindrical body, with pointed ogival nose. Cruciform tail control surfaces
Guidance and Control: Command guidance, with semi-active terminal homing. Control by tail surfaces
Warhead: High-explosive
Length: 17ft 0in (5.18m)
Body diameter: 1ft 4in (0.41m)

Development and Service

Studies for a new surface-to-air weapon system known as SAM-D began in 1965, following earlier US Army study programmes known as Field Army Ballistic Missile Defense System (FABMDS) and Army Air Defense System for the 1970s (AADS-70). After evaluation of competing industry proposals, Raytheon was awarded in May 1967 a contract covering the first year's advanced development of SAM-D, which is intended to replace Improved Hawk in the 1980s and beyond. Subsequent contracts covered demonstration of the advanced guidance system, operation of the radar in its various modes and the aerodynamic capabilities of the missile, leading to demonstrations of the full capability of the fire control group.

The missile and its shipping/launch container are being developed by Martin Marietta Corporation under sub-contract from Raytheon. Four missiles in their containers will be carried by each Patriot launch vehicle, from which they will be fired either singly or in close-sequence salvos at selectable azimuths and elevations, as required. In the field, a fire section will

USA



consist of the radar unit carrying phased-array radar, an engagement control station housing a weapons control digital computer, electric power supply and up to eight Patriot missile launching stations. In action, the multi-function phased-array radar acquires the target, tracks and illuminates it, and at the same time tracks the missile into its mid-course flight path. Then, during the terminal phase, the missile acquires the illuminated target and, aided by the ground-based computer, homes on the illumination until intercept.

Ten consecutive successful flights of the Patriot missile at the White Sands Missile Range, New Mexico, before the end of August 1974, to demonstrate the structural strength and

controllability during maximum manoeuvres, were followed by the start of a proof-of-principle flight test programme to demonstrate the effectiveness of the Track-Via-Missile (TVM) guidance. This phase accomplished the last of its assigned objectives on 16 September 1975, after only six firings, against non-maneuvring and manoeuvring targets, a target flying in formation and a target at low altitude in ground clutter. By the time 19 missiles had been fired, 18 had made successful intercepts and one had been declared a 'no test'. One of the successful launches in December 1976 was the first from a tactically configured launcher. The current development programme is expected to be completed in 1980.

Paveway

Homing bomb system. In production and service.

Prime contractor: Texas Instruments Inc
Guidance and Control: Texas Instruments laser seeker.
Warhead: 496-2,000lb (225-907kg) bomb

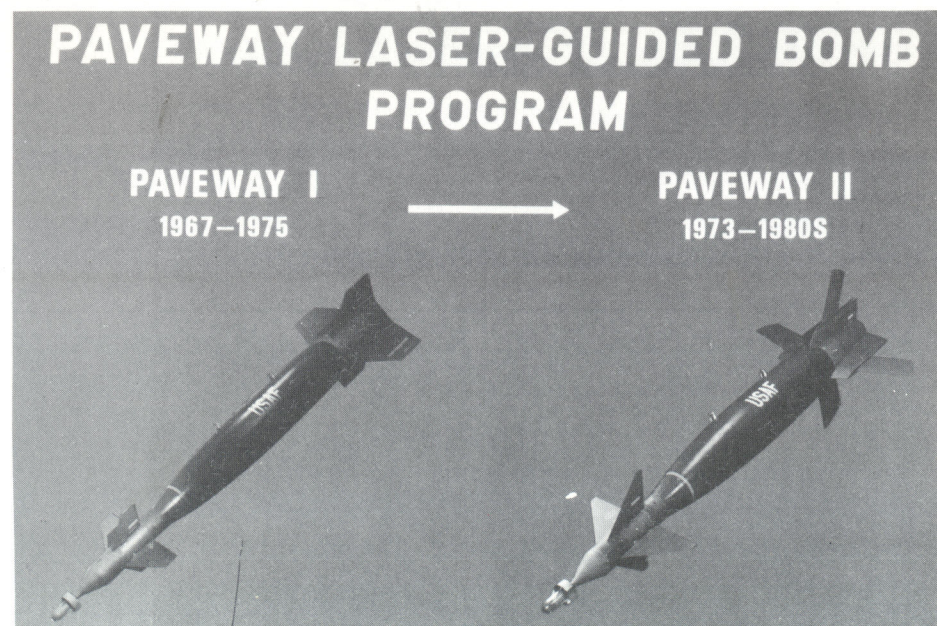
Development and Service

Similar in concept to the GBU-8 (HOBOS) produced by Rockwell International, the name Paveway covers a range of low-cost modular laser homing bombs. First used operationally in 1967 during the Vietnam conflict, the Paveway I has been followed by the improved Paveway II with retractable tail fins which increase its performance and adaptability. All the versions of the weapon use the same seeker and guidance unit, with only the aerodynamic surfaces varying to conform with the bomb used.

Paveway homing bombs are in service with the US Air Force and Navy, Royal Air Force and air forces

of other NATO and friendly countries, including Greece, Iran, Republic of Korea, the Netherlands, Saudi Arabia and Turkey.

USA



Penguin

Ship-to-ship tactical missile. In production and service.

Prime contractor: A/S Kongsberg Vaapenfabrikk
Powered by: Two-stage solid-propellant rocket motor

Airframe: Cylindrical body with swept cruciform wings mounted mid-way back. Small swept fins on tapered nose, indexed in line with wings

Guidance and Control: Inertial guidance, with infra-red terminal homing. Control by movable wings

Warhead: High-explosive, weighing 264lb (120kg), with contact fuse

Length: 10ft 0in (3.05m)

Body diameter: 11in (0.28m)

Wing span: 4ft 7in (1.40m)

Launch weight: 750lb (340kg)

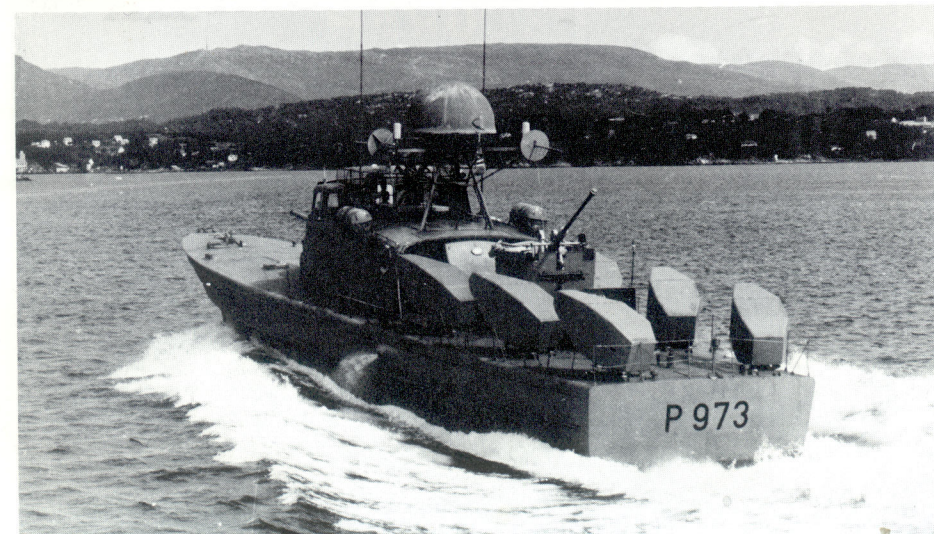
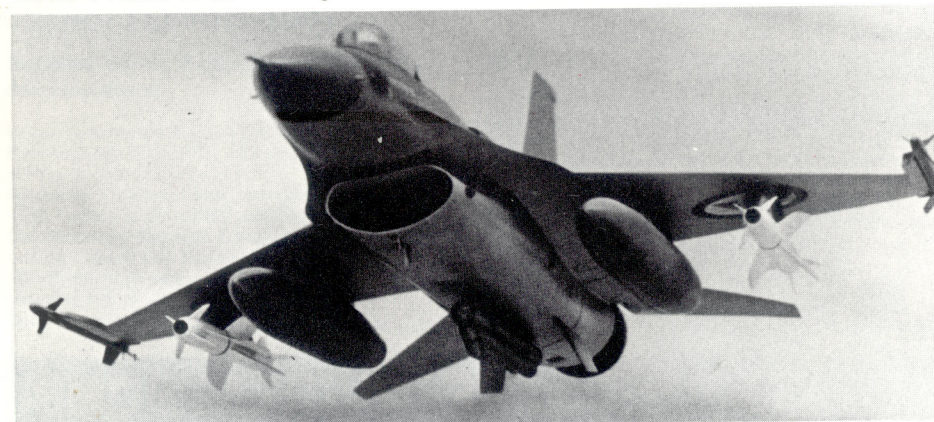
Cruising speed: Mach 0.8

Max range: Mk 1 11.5 miles (18.5km)

Mk 2 17 miles (27km)

Development and Service

The ship-launched tactical missile is operational in the Mk 1 version on Storm class gunboats of the



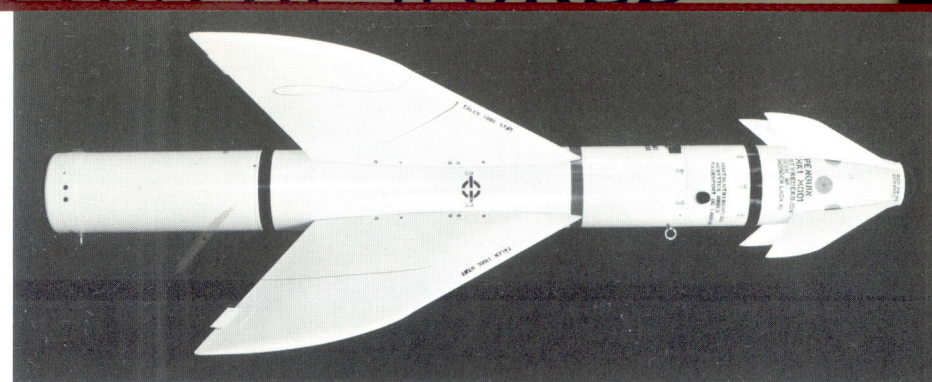
Norway

Royal Norwegian Navy, each of which can carry six Penguin launchers on its after deck. The Snogg class of torpedo boats each have four similar launchers; other are carried by Oslo class frigates, and by Kartal class fast attack craft of the Turkish Navy. A total of 40 Norwegians and foreign vessels carry the Mk 1 Penguin. An improved Penguin Mk 2 has been developed and is now in production for the Norwegian, Swedish and Greek navies. This version has a range of 17 miles (27km). It is expected to arm 36 vessels in total.

Penguin was developed by the Norwegian Defence Research Establishment and Kongsberg Vaapenfabrikk, the latter of which was then entrusted with quantity production. Penguin is fitted with a warhead similar to that of the Bullpup

Below: Model of an F-16 fighter armed with Penguin missiles.

Bottom: Storm class patrol boat carrying six Penguin launchers.



air-to-surface missile for which Kongsberg was European prime contractor. The container in which it is delivered serves also as the shipboard launcher and embodies the necessary launch-rail. The weapon is compatible with most existing types of naval fire-control systems, and is equally suitable for installation on shore bases for coastal defence,

helicopters and other platforms. A version of Penguin, known as the Mk 3, without the booster motor and with a smaller wing span is being studied as armament for jet fighters, with particular application to the General Dynamics F-16 ordered by several NATO air forces in Europe. This version was expected to go into the development phase in 1979.

Pershing (MGM-31A)

Surface-to-surface, selective-range artillery missile. In service (Pershing Ia) and under development (Pershing II).

Data: Pershing Ia

Prime contractor: Martin Marietta Corporation

Powered by: Tandem solid-propellant rocket motors. Thiokol M-105 in first stage and Thiokol M-106 in second stage.

Airframe: Two stage missile. Basically-cylindrical body, with long tapering pointed nose-cone. Three square vanes at base of second stage, indexed in line with three delta-shape tail control surfaces on first stage

Below: Pershing Ia missile system.



USA

Guidance and Control: Bendix Eclipse-Pioneer Division inertial guidance system, operating until cut-off and separation of second stage. Control by first-stage tail-fins and jet deflection, and second-stage vanes.

Warhead: Nuclear, in ablative re-entry vehicle, of approx 60-400 kiloton yield

Length: 34ft 7in (10.54m)

Body diameter: 3ft 4in (1.01m)

Launch weight: 10,246lb (4,648kg)

Range limits: 100-460 miles (160-740km)

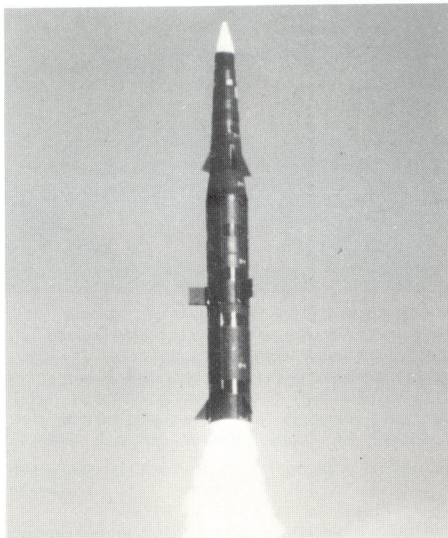
Development and Service

Martin Marietta's Orlando Division began development of Pershing in 1958, under the technical supervision of the US Army Missile Command, Redstone Arsenal, Alabama. Firing trials started in 1960 and achieved a higher success rate than those for any previous missile, with the result

that the weapon was deployed in 1964, first with the US Army and later, also, with the West German forces.

Pershing is a selective-range weapon, able to provide rapid-reaction support for a theatre or general support for a field army. A typical battalion has four firing batteries, a headquarters battery and a service battery. In its original form, the complete weapon system was mounted on four XM-474 tracked vehicles. Under the Pershing Ia improvement programme (now the only version in service), these were replaced by wheeled vehicles based on the Ford M656 five-ton truck, carrying new support equipment. This includes an automatic azimuth reference system which allows Pershing to be launched from unsurveyed launching positions, and a sequential launch adapter which reduces the response time in a quick reaction role. Pershing Ia vehicles comprise the improved erector-launcher, an articulated truck and trailer carrying the missile and its warhead and capable of travel over roads or cross-country; a transporter for the improved programmer/test station and power station; the firing battery control centre truck; and the radio terminal set vehicle with an inflatable antenna. The equipment is air transportable by the Hercules transport aircraft. The MGM-31A (originally M-14) operational missile was unchanged by this improvement programme and deployment by the US Army and West German forces began in 1969. A training version is in service under the designation MTM-31B (originally M-19).

Currently in advanced development is the Pershing II. It is a modular improvement of the Pershing Ia, which replaces the present inertial guidance system and re-entry vehicle with a new and highly accurate terminally-guided and controlled re-entry vehicle. This accuracy allows lower yield nuclear warheads to be fitted while still destroying hardened targets. A single Pershing II missile could



Above: Pershing II.

destroy some targets presently requiring attack by several Pershing Ias. The new missile system uses much of the existing equipment, including the Pershing Ia rocket motors and ground equipment.

Flight tests of the Radar Area Correlator guidance system have been conducted successfully and flight tests of the Pershing II missile have taken place.

A single-stage version of the Pershing missile is presently in the conceptual stage. It would allow two missiles to be carried on each launcher. Range would remain similar

Phoenix (AIM-54A)

Long-range air-to-air missile. In production and service.

Prime contractor: Hughes Aircraft Company
Powered by: Rocketdyne Mk 47 Mod O solid-propellant rocket motor

Airframe: Cylindrical body with ogival nose. Long-chord cruciform wings and cruciform tail control surfaces

Guidance and Control: Hughes radar-homing guidance system. Control by tail surfaces

Warhead: High-explosive, with proximity fuse
Length: 13ft 0in (3.95m)

Body diameter: 1ft 3in (0.38m)

Wing span: 3ft 0in (0.91m)

Launch weight: 985lb (447kg)

Cruising speed: over Mach 5

Range: over 124 miles (200km)

USA

Development and Service

Intended originally for the cancelled swing-wing F-111B tactical fighter, Phoenix offered such a great increase over the capability of earlier missiles that it was resurrected as primary armament of the US Navy's Grumman F-14 Tomcat. Maintenance and reliability are improved by the fact that the missile is made up of a number of self-contained sections, so that it can be handled as a complete unit or broken down for easy shipboard check-out and handling. In action, the target is located by the aircraft's Hughes AWG-9 weapon control system, which can lock on to the enemy in any kind of weather and launch Phoenix at optimum range. The pulse-Doppler radar of the AWG-9 enables it to 'look-down' and sort out a moving target from the ground clutter that obscures such targets in other systems. Its track-while-scan mode enables the fire control system to keep up to six missiles at a time on course while searching for further targets. The AWG-9 also



incorporates an infra-red subsystem that provides an independent search and track sensor. Terminal homing is by an active radar system in the missile.

Inert Phoenix missiles were first air-launched from an A-3A Skywarrior test aircraft in 1965. By March 1969, it was possible to intercept two Firebee target drones simultaneously with two missiles, while the targets were flying several miles apart. In August 1970, the 'look down' and track-while-scan features of the AWG-9 were tested in a launch against a Cougar jet fighter/drone flying many miles away and at lower altitude than the F-111B launch aircraft; the Cougar was destroyed. In June 1973 a Phoenix was launched from an F-14 Tomcat against a target drone, fitted with countermeasures, that was 126 miles (204km) away at the moment of launch. After climbing to 100,000ft (30,500m) during its trajectory the missile passed the drone within the lethal distance of the warhead fitted to operational rounds. Other tests proved, or so it was thought, the ability of the F-14/Phoenix to counter the threat of anti-shiping cruise missiles, to intercept multiple

Above: F-14A Tomcat fighter with six Phoenix missiles.

targets by simultaneous attacks with six missiles and to intercept high-flying Mach 3 fighters. However, according to a statement made by the General Accounting Office in 1979, the AIM-54A missile system is 'marginal at best against the current and postulated threat'. The first Phoenix production contract was placed by the US Navy in December 1970 and the first Phoenix-armed F-14 units became operational by 1974, deployed on USS *Enterprise*. By 1978, six US aircraft carriers were operating F-14s, when the number of AIM-54A missiles built had exceeded 1,700. The F-14s built for Iran are also armed with Phoenix. A second version of the missile, designated AIM-54C, is scheduled to enter initial low production of 60 missiles in FY 1980. This version will have increased ECCM capability and reliability, and will incorporate a new target detecting device, digital electronics unit and autopilot, and other improvements.

Pluton and Super Pluton

Tactical nuclear surface-to-surface missile. In production and service.

Data: Pluton

Prime contractor: Aérospatiale, Division Engines
Tactiques

Powered by: SEP Styx dual-thrust solid-propellant rocket motor

Airframe: Cylindrical body, with pointed ogival nose-cone and tail control surfaces

Guidance and Control: Simplified inertial guidance system based on SAGEM or SFENA stable platform linked to a computer. Control by electrically-actuated tail surfaces

Warhead: AN-51 tactical nuclear warhead, 25 kiloton yield, or 15 kiloton yield warhead.

Length: 25ft 1in (7.64m)

Body diameter: 2ft 1.5in (0.65m)

Fin span: 4ft 7.5in (1.41m)

France

Launch weight: 5,180lb (2,350kg)
Max range: 6.25-75 miles (10-120km)

Development and Service

This mobile tactical weapon system was developed and produced to replace the Honest John bombardment missiles which equipped battalions of the French Army. Firing trials of full-scale Pluton test vehicles started in 1969. The versions launched from the summer of 1970 were fully representative of the operational missile, complete with guidance system but without a warhead. Development of the nuclear charge progressed as part of the French programme of atomic tests in the Pacific, and Pluton was first deployed to the 3rd Artillery Regiment in May 1974. Five regiments of the French Army deploy Pluton, totalling 30 missiles although the original plans were for 120 missiles.

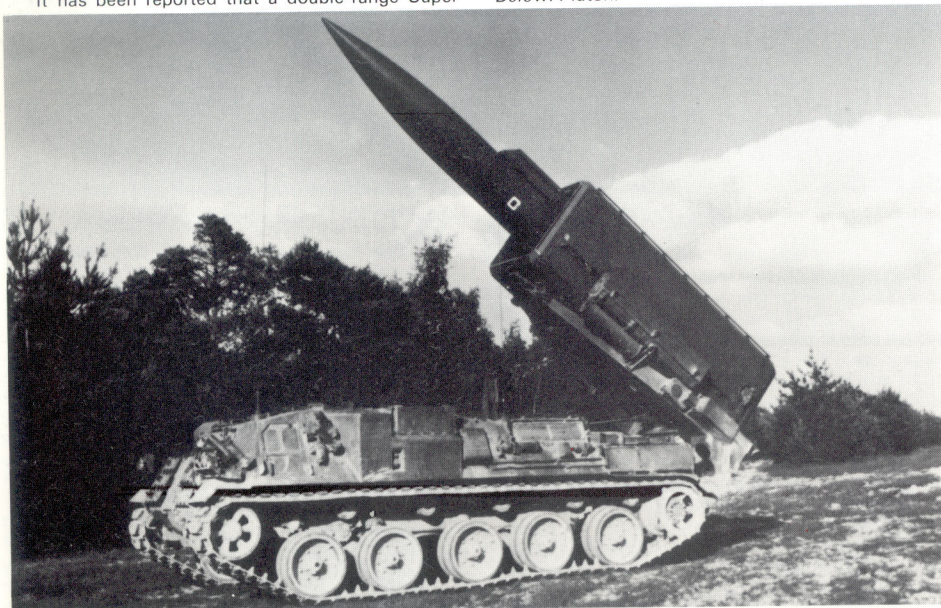
Aérospatiale is responsible for the missile and its

launching equipment, under the direction of the French Army's Division des Engins Tactiques. The missile and its warhead were supplied to operational units as two separate packages, with the missile container so designed that it serves also as the launch-tube when mounted on the tracked transporter-launcher. The latter is based on the AMX-30 tank chassis.

It has been reported that a double-range Super

Pluton has been under consideration since 1977 as a Pluton successor. Super Pluton would have improved performance and accuracy and interchangeable nuclear and conventional warheads, the former for destruction of major targets and the latter for attacking armoured vehicle concentrations using submunitions.

Below: Pluton.



Polaris (UGM-27)

Underwater-to-surface or surface-to-surface ballistic missile. In service.

Data: UGM-27C Polaris A3

Prime contractor: Lockheed Missiles and Space Company

Powered by: First stage Aerojet-General solid propellant motor of 79,360lb (36,000kg) thrust. Second stage Hercules Inc solid-propellant motor.

Airframe: Two-stage missile. Cylindrical body with ogival nose-cone. First- and second-stage casings of glass-fibre. No fins or wings.

Guidance and Control: Inertial guidance system developed under responsibility of Massachusetts Institute of Technology and manufactured by General Electric and Hughes. First stage control by gimballed nozzles, and second stage by a thrust-vector system utilising fluid injection.

Warhead: Thermonuclear, in multiple re-entry vehicles (three of 200 kiloton yield each).

Length: 32ft 4in (9.85m)

Max body diameter: 4ft 6in (1.37m)

Launch weight: 35,000lb (15,850kg)

Max speed: 6,600mph (10,620km/h)

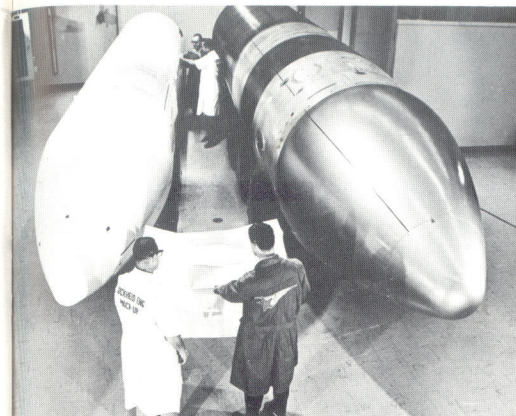
Max range: 2,875 miles (4,630km)

Development and Service

When the idea of launching a long-range ballistic missile from a submarine was first suggested, the problems seemed insurmountable. By 1956, advances in solid propellants, guidance systems and warheads offered the possibility of achieving a range comparable with that of land-based intermediate-range ballistic missiles then in production with a weapon only one-quarter their weight. Lockheed Missiles and Space Company (LMSC) began design studies for a missile that would go into a launch-tube on a specially-built submarine. The Autonetics Division of North American and Sperry started developing a Ship's Inertial Navigation System (SINS) that would establish the latitude and longitude of a submarine precisely and so ensure an accurate trajectory for any missile fired from it.

Firings of test missiles ashore and from the surface ship USS *Observation Island*, led to the first

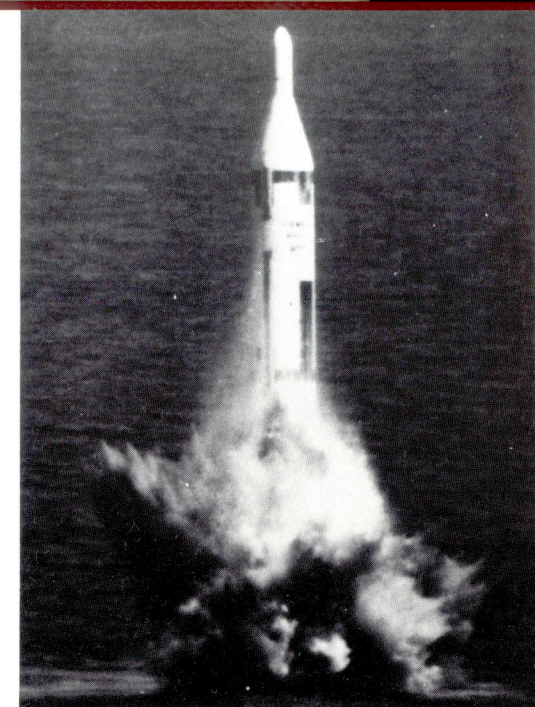
USA



Above: Polaris A3 (left) with Poseidon C3.

Right: Polaris A2 underwater launch.

underwater launches in 1960. These culminated in the successful firing of two UGM-27A Polaris A1 missiles from a submerged submarine the USS *George Washington*, on 20 July of that year. This was a nuclear-powered ship which had been modified during construction to have a section containing 16 launch-tubes inserted amidships. The 40 missile submarines which followed for the US Navy, and four for the Royal Navy, were all specially built. The original UGM-27A was eventually superseded by the improved UGM-27B Polaris A2 (weight 30,000lb (13,600kg); range 1,700 miles



Poseidon (UGM-73)

Underwater-to-surface or surface-to-surface ballistic missile. In service.

Data: UGM-73A Poseidon C3

Prime contractor: Lockheed Missiles and Space Company

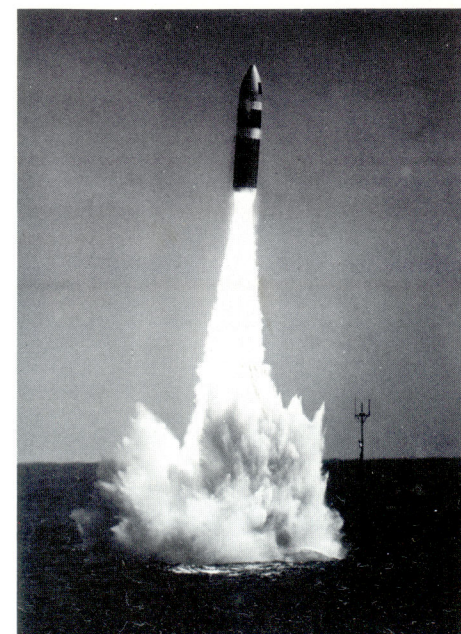
Powered by: First stage Hercules or Thiokol solid-propellant motor. Second stage Hercules solid-propellant motor.

Airframe: Two-stage missile. Cylindrical body with ogival nose-cone. First- and second-stage casings of glass-fibre. No fins or wings.

Guidance and Control: Inertial guidance system developed under responsibility of Massachusetts Institute of Technology and manufactured by General Electric and Raytheon. Thrust-vector control by one movable nozzle on each stage, actuated by gas generator.

Warhead: Thermonuclear in multiple, independently-targetable re-entry vehicles.

Right: Poseidon C3.



USA

developed by LMSC and Atomic Energy Commission (10 or 14 of 50 kiloton yield each)

Length: 34ft 0in (10.36m)

Max body diameter: 6ft 2in (1.88m)

Launch weight: 65,000lb (29,480kg)

Max range: 2,875 miles (4,630km)

Development and Service

Having established the value of a submarine-launched strategic missile system with Polaris, the US Navy decided in 1965 to evolve the more formidable Poseidon to take advantage of new developments in missile technology. It was possible to pack larger missiles on board existing Polaris A3 submarines with only minor modification to the launch-tubes. This enabled Lockheed Missiles and Space Company (LMSC) to utilise larger motors and improved equipment and so offer double payload

and twice the accuracy of Polaris. When added to the advantages that come from use of an MIRV warhead, these advances make Poseidon far more formidable than its predecessor.

Firing trials with Poseidon test rounds began on 16 August 1968. By June 1970 the initial batch of 20 missiles had all been launched, 17 of them from pads ashore and three from tubes on the surface ship USS *Observation Island*. Underwater launch trials began on 3 August 1970, when a Poseidon was fired from the USS *James Madison*, the first submarine that had been fitted with modified launch-tubes and improved navigation and fire control systems for the new weapon. Subsequent development was so rapid that the *James Madison* was declared operational in March 1971. All 31 submarines planned for modification are now operational, although 10 are to be modified further to carry the new Trident missile. Each Poseidon submarine carries 16 missiles.

Quail (ADM-20C)

Air-launched decoy missile. In service.

Prime Contractor: McDonnell Aircraft Corporation
Powered by: General Electric J85-GE-7 turbojet of 2,450lb (1,112kg) st

Airframe: Aeroplane configuration. Rectangular body, with rounded nose. Short, high-set, folding cropped-delta wings at rear, each with a vertical tail-fin at mid-span and another projecting downward from the wingtip. Ram air-intake on each side of body

Guidance and Control: McDonnell autopilot

Warhead: None, but self-destruct device is fitted to prevent missile being recovered by enemy

Length: 12ft 10in (3.91m)

Launch weight: 1,200lb (545kg)

Cruising speed: Mach 0.9

Range: over 250 miles (400km)

Development and Service

Until the AGM-86A air-launched cruise missile (ALCM) is ready for service, Quail will remain unique in USAF service. Its sole task is to fly pre-planned

'patterns' in enemy airspace, so that it will be picked up on early warning, missile and interceptor fighter radars and confuse the defences. This is made possible by one of several electronic devices packed into Quail's glassfibre body, which ensures that the tiny decoy produces the same 'blip' on a radar screen as the huge B-52 Stratofortress bomber from which it is air-launched.

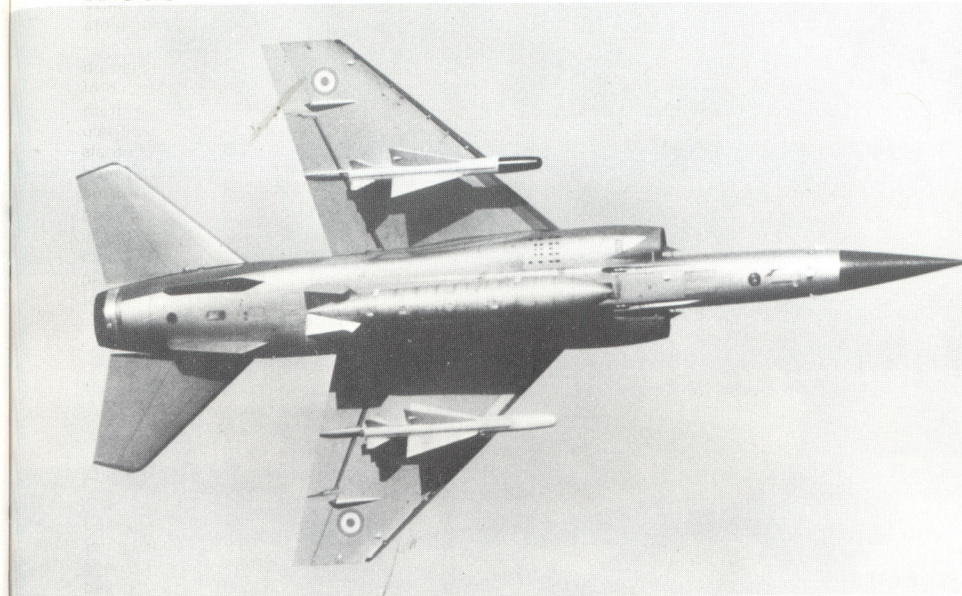
McDonnell began developing Quail, as the XGAM-72, in 1955. By June 1960, a B-52 was able to drop three Quails in rapid succession in an operational-type pattern over Eglin AFB. Before the end of that year, the first of the improved production-type ADM-20B Quails showed its paces in pre-programmed multi-flight tests in the same altitude and speed ranges as the B-52. Deployment to Strategic Air Command bases was completed between March 1961 and January 1962.

Four Quails can be packed into a small launch package, with their wing and tail surfaces folded, for stowage in the bomb-bay of the B-52. Just before launch the engine is started and the wings and fins extend. The current operational version is designated ADM-20C.

USA

R.530

France



Air-to-air missile. In production and service.

Above: Mirage F1 with underwing R.530s.

Prime contractor: SA Matra

Powered by: Hotchkiss-Brandt two-stage solid-propellant rocket motor of 18,740lb (8,500kg) st

Airframe: Cylindrical body, with slightly tapering and rounded nose. Cruciform delta wings, of which two have ailerons, indexed in line with cruciform tail control surfaces. Glass-tipped nose on infra-red version

Guidance and Control: Alternative AD-26 semi-active radar or infra-red homing. Control via ailerons and movable tail surfaces

Warhead: Hotchkiss-Brandt, weighing 60lb (27kg), with proximity fuse

Length: 10ft 9.25in (3.28m)

Body diameter: 10.25in (0.26m)

Wing span: 3ft 7.25in (1.10in)

Launch weight: 430lb (195kg)

Max speed: Mach 2.7

Max range: 11 miles (18km)

Development and Service

More than 3,000 R.530 air-to-air missiles have been built, and these formidable weapons are carried as standard armament under the fuselage of Mirage III interceptors and under the wings of Mirage F1s of the French Air Force. They have also been exported to 14 nations, including Argentina, Australia, Brazil, Colombia, Pakistan, Venezuela and South Africa, and are carried on each side of the front fuselage of the French Navy's F-8E(FN) Crusaders.

The R.530 is an all-weather missile, suitable for use at heights from sea level to 69,000ft (21,000m). The alternative types of homing head are sensitive enough to pick up the target during attack from any direction; unlike some infra-red missiles which must be launched from behind the target in order to lock on to the heat from its jet efflux. The latest anti-jamming ECM devices are fitted to the AD-26 radar head.

R.550 Magic

France

Short/medium-range air-to-air 'dogfight' missile. In production and service.

Prime contractor: SA Matra

Powered by: SNPE Romeo solid-propellant rocket motor

Airframe: Slim cylindrical body with rounded nose. 'Double-canard' configuration, with movable foreplane control surfaces immediately behind and indexed in line with cruciform fixed wings. Cruciform tail-fins also indexed in line

Guidance and Control: Infra-red homing system. Control by foreplanes